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## Using Problem-Based Learning for Occupational and Environmental Health Nursing Education:

### Pesticide Exposures Among Migrant Agricultural Workers

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### Abstract

Problem-based learning, which emphasizes group collaboration to solve real-world case scenarios, is an instructional approach that is well suited to occupational and environmental health nursing education. Learners actively work through case studies rather than passively receive information presented through lectures. Problem-based learning methods promote critical thinking skills and motivate learning, preparing learners for professional practice in complex, ever-changing environments. Despite these advantages, problem-based learning is underutilized in nursing education compared to more traditional lecture methods. This article presents key concepts of problem-based learning, discusses problem-based learning in educating occupational and environmental health nurses, and describes the development of a problem-based learning case aimed at increasing occupational and environmental health nurses' capacity to address pesticide exposure among migrant and seasonal agricultural workers.

In their practice, occupational and environmental health nurses encounter a variety of complex situations and issues that call for mature critical thinking skills and the ability to examine problems from a multidimensional perspective; the educational preparation of occupational and environmental health professionals must provide them with both capabilities. Problem-based learning is a teaching method that can be used to effectively build occupational and environmental health knowledge and competence needed for nursing practice. This article discusses the characteristics of problem-based learning and its utility for preparing occupational and environmental health nurses for the workplace. It also presents a case developed to educate graduate nursing students about pesticide exposure as an example of a successful application of problem-based learning in an occupational and environmental health nursing program.

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## BACKGROUND OF THE PROJECT

Pesticide exposure is a problem of significance to occupational health and safety professionals. Health professionals in all settings, both rural and urban, can play critical roles in recognizing adverse pesticide effects. For example, in Washington State, health care workers' reports implicating the pesticide mevinphos in a cluster of illnesses among agricultural workers triggered a review by the Department of Health (Skeers & Morrissey, 1995). As a result of this investigation, several state agencies collaborated to improve regulations and remove the product from the market. In another instance, data collected in states that conduct surveillance of pesticide-related illness (California, Florida, Louisiana, Michigan, New York, Oregon, Texas, and Washington) contributed to increasing awareness of the health effects of total release foggers (TRFs), used to apply pesticides in private homes (U.S. Department of Health and Human Services, 2008). In these states, the information reported by alert health care providers revealed poisoning patterns (i.e., poisonings were often associated with failing to vacate while the pesticide was discharged from the TRF, re-entering the area too soon after pesticide application, failing to warn neighbors and others nearby, or using too much pesticide for the area to be treated). These findings were subsequently used to educate the public and prevent future harm.

To be most effective, health care professionals need the knowledge and skill to recognize and adequately address the effects of these exposures on their clients and the communities they serve. Pesticides are widely used in public and commercial sectors to control pests; however, the adverse effects these chemicals have on the health of workers, their families, and the public are often not considered. Nurses and other health professionals typically receive little information about pesticide exposure during their undergraduate or graduate education. Studies have documented that although health professionals believe environmentally related health problems should be managed, they report being unprepared to do so, citing a lack of education, inadequate resources, and time limitations (Karr, Murphy, Glew, Keifer, & Fenske, 2006; Mujuru & Niezen, 2004; Sanborn & Scott, 1998; Van Dongen, 2002; Woolf & Cimino, 2001).

In response to this recognized need, the U.S. Environmental Protection Agency (EPA, 2005), Office of Pesticide Programs, provided funding to stimulate the development of strategies to improve the recognition and management of pesticide-related health problems among students in health care professions programs. This led to the implementation of a multifaceted program to improve pesticide education of nurses and other health professionals in four universities in the northwest United States. The overarching focus of this program was to create pesticide-related educational resources for nursing, medical, and physician assistant students. As part of this effort, a case study was developed for a graduate occupational and environmental health nursing course at one of the universities located in Washington State, introducing concepts related to pesticide exposures among migrant workers in agriculture. At the time of implementation, the nursing course was being restructured to use problem-based learning as the instructional framework. Accordingly, the pesticide case study was developed using the problem-based learning format. Problem-based learning can be an effective method for presenting students with issues related to population-level pesticide exposure, just one of the many complex situations they may encounter in professional practice.

## PROBLEM-BASED LEARNING: AN OVERVIEW

With problem-based learning, students learn by actively working through case studies rather than passively receiving information through lectures. Gordon (2001) describes five characteristics of problem-based learning: (1) it is problem-based, meaning it centers around

problems often taken from real-life situations; (2) it is reiterative, referring to the need for students to continually reevaluate what they know and what information is still missing; (3) it is learner-centered, meaning the learning process is directed by students; (4) it engages small groups (generally from five to seven individuals); and (5) it is facilitated by an expert faculty member who guides rather than leads the learning process, is available to answer questions, and ensures that students meet stated learning objectives. Problem-based learning can be used in a variety of ways, depending on the goals of the course or program, setting, and students' educational needs. It may be used as a principal approach (Magnussen, Ishida, & Itano, 2000; McLoughlin & Darvill, 2007; Ozturk, Muslu, & Dicle, 2008), incorporated as an adjunct to complement primarily lecture-based programs (Edwards et al., 1998; Hwang & Kim, 2006), or used to test and reinforce knowledge from prior courses (Amos & White, 1998).

Proponents of problem-based learning claim that its unique characteristics enhance the educational experience, and that from problem-based learning, students develop the motivation and skill needed for lifelong learning. Previous reports have described positive results from its use in nursing programs. Yuan, Williams, and Fan (2008) found that nursing students enjoy the problem-based learning format and report that it leads to improvements in a variety of outcomes, including critical thinking, application of knowledge, active participation in learning, group cooperation, and self-direction. Educators have reported that it is impossible to present explicitly in a curriculum every situation that a nurse might encounter in practice (McLoughlin & Darvill, 2007). Problem-based learning encourages students to seek and appraise a wide variety of information sources that can be consulted throughout their careers as problems and challenges arise. Problem-based learning has also been cited as an ideal way to prepare students for practice in a complex, evolving health care environment (Amos & White, 1998; Edwards et al., 1998). Although both students and instructors realize that problem-based learning cases are more time-consuming than lectures, they acknowledge that the extra effort is rewarded with a higher-quality learning experience (Amos & White, 1998; Edwards et al., 1998). Nursing students in problem-based learning classes have responded positively to course evaluations, stating that the format fosters a comfortable and interactive classroom environment, builds skills in teamwork and time management, allows for an individualized learning experience, provides a broad and reality-based education, and raises awareness of community resources (Amos & White, 1998; Edwards et al., 1998). Problem-based learning may also be a positive recruitment tool (Amos & White, 1998), attracting students who see its potential to enhance their learning, employability, and effectiveness in anticipated professional roles (McLoughlin & Darvill, 2007).

Some quasi-experimental studies and randomized controlled trials have also documented the benefit of problem-based learning in nursing education, although these results should be interpreted cautiously because the highly situation-dependent nature of educational settings and curricula limits their generalizability. Ozturk et al. (2008) reported a positive effect of problem-based learning when they compared critical thinking scores of Turkish students attending two different nursing schools, one of which used problem-based learning. Although students in both schools generally scored only moderately on critical thinking, the scores of the students in the problem-based learning group were significantly higher than those of the students whose program used a lecture format. Similarly, Hwang and Kim (2006) found that students in a problem-based learning course in adult health nursing demonstrated increases in course content knowledge, whereas in a similar course using a lecture format, significantly more knowledge acquisition was only found among those students who received the highest grades in the course. This same study also showed that students in the problem-based learning course had higher levels of learning motivation. Somewhat conflicting findings were reported by Magnussen et al. (2000), who found that

among students enrolled in a problem-based learning-oriented nursing program, those who scored low in critical thinking at the beginning of the program significantly improved their scores by the end of the program. However, this was not true for students scoring in the middle or high range of critical thinking at baseline. Those with the highest baseline critical thinking scores actually demonstrated lower scores in this area at the end of the problem-based learning program. Further research is needed to better characterize the relationship between problem-based learning and its effects on variables such as knowledge and critical thinking.

Occupational and environmental health practice is complex and interdisciplinary and requires a unique set of skills that may not be fostered by lecture-style education alone. The issues and problems that occupational and environmental health professionals encounter are often multidimensional and can rarely be resolved with a formulaic, textbook approach. Occupational and environmental health nurses must be flexible, creative, collaborative, and able to access and use a range of resources—skills consistent with the pedagogical basis of problem-based learning (Amos & White, 1998; Edwards et al., 1998; Schlenker & Kerber, 2006). Despite this, problem-based learning is still underutilized in nursing programs, including occupational and environmental health nursing education. This underutilization may be due in part to the current lack of published examples demonstrating the application of problem-based learning from which educators can draw (Hwang & Kim, 2006; McLoughlin & Darvill, 2007; Yuan et al., 2008). Problem-based learning is an unfamiliar learning and teaching format for many, and some instructors may prefer to rely on traditional, more familiar methods. The case presented here provides an example of the successful use of problem-based learning as part of a graduate occupational and environmental health nursing course. As reports of problem-based learning in the classroom become more prevalent in the literature, and more students and teachers begin to have personal experiences with this method of instruction, its benefits may be more widely recognized.

## **APPLICATION OF A PROBLEM-BASED LEARNING CASE TO AN OCCUPATIONAL AND ENVIRONMENTAL HEALTH NURSING COURSE: PESTICIDE EXPOSURE AMONG MIGRANT AGRICULTURAL WORKERS**

The problem-based learning case described in this article is available in its entirety in the Sidebar. The authors delineate the elements of this case that typify the problem-based learning methodology and format. One such characteristic is that it was open-ended. Students were given a specific assignment, although they were not provided with prescriptive directions as to how to complete the task. Students were required to use reliable sources (e.g., published research, government reports) to support their end product. This requirement was intended to prevent students' relying on untested assumptions rather than seeking legitimate sources of information (Edwards et al., 1998). Additionally, the case reflected the complexity of a real-world situation. This case required students to consider how multidimensional factors and influences serve as determinants of occupational and environmental health situations and issues. Various aspects of pesticide exposure were included in the case description (e.g., occupational, community, and take-home exposures; social and cultural aspects of workers' health beliefs; federal and state regulations relevant to pesticide use; and the potential challenges that occupational and environmental health professionals face when advocating for workers' health). These interrelated layers of influence are a hallmark of the ecological model, a comprehensive framework conceptualizing health outcomes resulting from the interplay of factors at both individual and systems levels (Bronfenbrenner, 1977; Salazar & Primono, 1994; Stokols, 1996). The open-ended format allowed for the presentation of subject matter that would be difficult to

fit into a lecture and encouraged the development of skills needed to solve this multidimensional, complex occupational and environmental health problem.

The target audience of a problem-based learning case determines which characteristics and professional roles are emphasized. Although the exemplar case was developed for an occupational and environmental health nursing course, it was written to accommodate students from other occupational and environmental health disciplines (e.g., occupational medicine, industrial hygiene) as well. In graduate courses, students pursuing a variety of degrees across specialty areas often learn side-by-side in the classroom. Therefore, this case was purposefully designed for an interdisciplinary group of learners. As such, students were instructed to play the roles of community health clinic employees, rather than more nursing-specific roles. The disciplinary composition of each small group determined their collective perspective as they worked through the case drawing on the strengths of each group member. The adaptability of problem-based learning to a range of audiences is one of its benefits. When used in a course where students come from a variety of degree programs (i.e., undergraduate, master's, and doctoral) and disciplines, it replicates the interdisciplinary, collaborative processes they will encounter in professional practice.

### **Exemplar Pesticide case (Problem-Based Learning)—“Something Bad in the Air”**

#### **Objectives**

1. Describe a public health concern that contributes to disparate health among migrant workers in the agricultural sector.
2. Consider how political, economic, and societal determinants contribute to occupational or environmental exposures among immigrant and racial or ethnic minority workers.
3. Appraise the ecological model approach as a conceptual framework for assessing the determinants of an occupational or environmental health issue.

Your group works for a community-based health clinic that specializes in providing health and human services to Latino communities in the northwest region. The county where the clinic is located is populated by a large number of seasonal and migrant Latino workers who arrive every spring and summer to work on local farms in the area. Because of clinic staff concerns about the lack of access to health care services in this community, the clinic recently applied for and received grant funding to conduct outreach to migrant farm workers.

Seasonal farm workers and their families often live in housing on or near their farms, provided by their employers. From the employers' perspective, this arrangement offers the convenience of easy transport to and from the fields, even on short notice. Workers do not pay directly for this housing, but conditions may be rustic. Up to eight individuals may sleep in each unit, which may include a small kitchen with a hot plate. Showers and toilet facilities may be located in a common area of the camp and shared by all residents. For families who return to the same farm year after year, camp living provides a sense of community.

Your team begins to visit several of these camps one evening a week. You meet with the farm worker families to assess their health concerns and needs, offer some basic health education, and provide referrals to the clinic as needed. During your visits to one camp, you readily observe that the housing units are closely adjacent to the fields. The fields are regularly sprayed for pests, which raises your level of concern that pesticide exposures could be occurring in this population, either at work or at home.

Pesticides are chemicals designed to kill or otherwise eliminate insects, rodents, molds, and other pests. This is a broad class of chemicals with a variety of known or suspected effects related to short- or long-term exposure ranging from dermatitis and allergies to neurological and reproductive problems. Farm workers are at higher risk from these exposures than the general population, and migrant workers and racial or ethnic minorities may be particularly vulnerable. Occupational exposures may occur as workers mix or apply pesticides, or while working in the fields after they have been treated for pests. The families of farm workers may also be subject to take-home exposures or airborne drift if they live close to the farm.

One evening, while in the camp, you notice several of the male pesticide sprayers returning from work to greet their families. Seeing that they appear to be wearing the same clothes and boots that they wore in the fields, you ask them what they know about protecting themselves and their families from pesticides. One man, Ernesto, tells you that their employer trained them at the beginning of the season on the safe use of pesticides. He states that he is not personally concerned about exposures to pesticides because, as a sprayer, he was given gloves and a mask that he uses while spraying the fields using a backpack device. In addition, he is not worried about health effects because “we’re tested every 6 months.” Some of the other men chime in that they are sure that the pesticides would not be allowed on the market if they were really harmful.

The next day, one of the farm owners contacts you at your clinic and asks you to stop discussing pesticides with his workers, stating that it “just makes them paranoid.” Additionally, he points out that he provides a workplace training program as mandated by the EPA Worker Protection Standard, and he feels that it is not the place of health care workers to be distributing this information to workers.

You are concerned about preventable occupational and environmental pesticide exposures in this community. In thinking about this issue, you ask yourself the following questions—What are the potential health effects of the specific pesticides used to treat raspberry, blueberry, and strawberry crops (consider the U.S. Agricultural Census Survey to identify commonly used pesticides)? What kinds of tasks might workers do that would expose them to pesticides? How might workers’ families and children living in the camp be affected? What are some issues that might prevent migrant farm workers from protecting themselves and their families? What are the legal requirements of employers, with regard to pesticide education, as mandated by the 1994 EPA Worker Protection Standard? What other concerns might employers have? What are the legal rights of immigrant workers, including migrant agricultural workers? What are the ethical considerations? What would be the best way to approach these workers and their employers?

You recognize that many factors contribute to the particular vulnerability of this group of workers to the health effects of pesticides and think that individual interventions alone may not be sufficient to address this health issue. Occupational and environmental health problems are often complex and multidimensional and may have several different “causes.” These influencing or determining factors are called “determinants.” These determinants usually do not contribute in equal proportions to a given problem. Often, multiple determinants may need to be approached simultaneously to effectively address the overall problem. The determinants you identify not only describe the factors that lead to the problem, but can also become potential opportunities for prevention or intervention strategies. Examples of some categories of determinants include those that are biological, social and cultural, environmental, economic, and political.

### Assignment

Submit a detailed list of the key determinants for the problem above and describe each determinant in depth. At a minimum, attempt to include some determinants from each of the categories above. You might also be able to identify some additional classes of determinants that are not listed. Each determinant should be supported by credible sources (in particular, published research) and cited appropriately. Also, illustrate, classify, and describe the relationships between your identified key determinants in a diagram applying the ecological model.

#### **Evaluation criteria**

Articulation of the determinants relevant to pesticide exposure and related health effects among migrant farm workers. (4 = excellent, 3 = well, 2 = acceptable, 1 = poor)

Support for each determinant by credible sources, particularly current research. (4 = excellent, 3 = well, 2 = acceptable, 1 = poor)

Application of the ecological model to characterize relationships between key determinants and health. (4 = excellent, 3 = well, 2 = acceptable, 1 = poor)

Comprehensiveness of key determinants within each layer of the ecological model. (3 = well, 1 = poor)

Problem-based learning cases can be hypothetical, but may be more meaningful to students if they come from timely, relatable real-life situations (Gordon, 2004). In preparation for writing the pesticide case, interviews were conducted with several health professionals, including nurses and health educators, who had engaged in outreach work similar to that depicted in the case. The resulting case reflected a composite of their experiences and the published literature. The case included several regional and local references (e.g., geographic landmarks and a local group of community health clinics). Pesticide exposure is also of particular interest and relevance to students in Washington State, where agriculture is a \$6 billion industry (Stromsdorfer, 2007) employing 2.6% of all workers statewide but as much as 28.9% of the work force in some regions (Glenn, 2004). Forty-two percent of Washington State agricultural workers are Hispanic, 33% are not U.S. citizens, and many are seasonal workers (Glenn, 2004). As such, students recognized the concerns of migrant agricultural workers as relevant to their future practice, thus increasing their investment in the case.

The elements of a problem-based learning case scenario include characters, places, processes and systems, protagonist(s), a time line of key events, and decision points for the protagonists (Gordon, 2004). Each of these should guide students toward achieving specific learning objectives. Faculty must avoid providing details that are not relevant to solving the case because students may focus on these at the expense of more salient details (Gordon, 2004), misusing time and experiencing frustration. Writing effective cases can be a challenge, especially as instructors attempt to include comprehensive course content. The featured case included a variety of aspects related to pesticide exposure to provide students with the possible determinants. However, the text avoided details about particular crops or pesticides or the individual workers and families involved to avoid unnecessary distraction. The intent of this specific case was to familiarize students with an ecological perspective for addressing a multidimensional, community-level health problem, which the details in the case guided them to do.

Two other components of a problem-based learning case that help students focus on only significant aspects are unambiguous learning objectives (Gordon, 2004) and grading criteria by which their completed assignment is evaluated. Specific learning objectives for the case

followed directly from the overall goals for the course. For this occupational and environmental health nursing course, the objectives of the pesticides case focused on identifying multidimensional determinants of pesticide exposure among migrant agricultural workers by applying an ecological perspective. The case opened with stated learning objectives and closed with an explanation of the assignment and grading criteria; thus, the scenario was embedded to help students remain grounded in the practical requirements of the case. In problem-based learning, end products can range from a written manuscript or presentation to a description of the small-group process. Clear instructions, faculty expectations, and criteria against which students will be evaluated focus students' efforts so they can use their time effectively and overcome the anxiety they may experience when encountering this open-ended case format.

Although the goal of problem-based learning is for students to independently seek sources of information, educators may wish to provide a few "starter" resources. These resources can give students an idea of how to solve the case and also ensure that key points are covered. As introductory resources, the pesticide case was accompanied by a few peer-reviewed journal articles, including one describing characteristics of the immigrant work force, and a videotaped lecture explaining the ecological model, an understanding of which was necessary to complete the assignment and meet the learning objectives. The case also included a sidebar with basic facts about pesticide exposure and regulatory requirements in Washington State. Problem-based learning should help students identify their strengths and preexisting knowledge (Gordon, 2001); however, the material presented in the case may be entirely new to some students, and providing background resources may be essential.

If instructors other than the authors use a case, an accompanying instructor's guide should be developed (Edwards et al., 1998). An instructor's guide was developed for the pesticide case to support classroom implementation. The guide contains background information on migrant agricultural workers, pesticide exposures, and the ecological model, as well as additional resources for instructors and students. Instructors, in their role as facilitators, can use these resources to expand their own knowledge and provide additional information to interested students at the completion of the case. The guide also included principles for implementing a problem-based learning case to assist instructors not familiar with the method.

Logistical considerations may dictate some of the characteristics of the case, possibly requiring modifications to the problem-based learning format. Problem-based learning can be time-consuming, and some students and facilitators may feel rushed during the process (Edwards et al., 1998). Instructors must allow sufficient time, within the constraints of the course schedule, for students to complete a case. Some experts advise addressing complicated cases over several weeks (Center for Teaching and Learning, 2001). Also, inherent in the problem-based learning format is the expectation that students devote time outside of designated in-class meetings. Although some experts believe that problem-based learning is most effective when used consistently across all courses in an academic program, this approach is unlikely in nursing schools. If students have not previously encountered the problem-based learning format, as was the case for this occupational and environmental health nursing course, additional time may be required to orient them. Finally, the instructor should decide whether the course will follow a strict problem-based learning format or if problem-based learning will be supplemented by occasional lectures. Some have found that students are frustrated by the effort needed to meet the expectations in a problem-based learning course, which can lead to loss of confidence. This result may be alleviated by receiving key information through lectures (Hwang & Kim, 2006). Incorporating lectures into the problem-based learning format can also overcome limitations in time, staffing, or resources (Edwards et al., 1998). Lectures can complement the problem-based learning

cases by introducing each case, emphasizing key content, or discussing strategies for successful navigation of the problem-based learning format.

Finally, when developing a problem-based learning case, instructors should be prepared for an ongoing process of revision (Gordon, 2004). When implementing a case for the first time, student feedback should be solicited on completion of the case or through end-of-course evaluations. Subsequent revision, refinement, and adaptation should be an ongoing process (Center for Teaching and Learning, 2001). Although the pesticide case was purposefully crafted using recommended features of problem-based learning, the case will benefit from future modification. Each time a new group of students works through a case, new features and problems with the case are uncovered. Additionally, many community and occupational and environmental health issues, including pesticide exposures, continuously evolve with the discovery of new scientific information and shifting political and regulatory climates. Cases require revision on a periodic basis to ensure the content remains current.

## CONCLUSION

This article provided an illustration of the use of problem-based learning in occupational and environmental health nursing education. Because pesticide exposures among migrant agricultural workers pose multidimensional challenges, as do most occupational and environmental health issues, problem-based learning provided an effective strategy to deliver this content. Additionally, problem-based learning's open-ended nature, emphasis on real-life scenarios, and small-group problem solving effectively prepare occupational and environmental health nursing students to address the complexities of current and emerging occupational and environmental health issues. Although problem-based learning is not widely used in nursing education, it is well suited to preparing students for complex problems they will encounter as occupational and environmental health professionals. As a learning methodology, it captures the interdisciplinary nature of the professional work environment and provides students with opportunities to develop critical thinking skills, confidence, and independence. Additionally, problem-based learning is a flexible format that can be used successfully in a variety of circumstances. As interest in this pedagogical format grows, educators should share their knowledge and experiences to support its best use in nursing curricula.

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### IN SUMMARY

1. Problem-based learning is an instructional approach that uses complex, real-world case scenarios to challenge learners to formulate solutions drawing on previous knowledge and a wide variety of information sources.
2. Problem-based learning is well suited for preparing occupational and environmental health professionals for the complex issues they will encounter in an ever-changing health care environment. Despite this, nursing educators interested in problem-based learning may discover few documented examples of its use in occupational and environmental training from which they can draw.
3. A problem-based learning case was integrated into a graduate occupational and environmental health nursing course to introduce concepts and issues related to pesticide exposures among migrant agricultural workers. This case is provided as a practical example of problem-based learning in occupational and environmental health education.